MICROSTRIP PATCH ANTENNA FOR IOT APPLICATIONS

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ABSTRACT

Now a days IoT is the most preferred technology to develop wireless communication between the nodes. The cardinal source is the antenna, which is versatile and compatible in nature. Micro Strip antenna is easy to fabricate and get connected to nearby IoT devices even in remote areas. Simulation achieved by using CST Studio suite software. As most of the IoT devices are embedded designed on chips and PCB’s, these microstrip antenna occupy less space with more gain and easy to integrate in small space. Though we have many methods to design antenna and implementation process, we select one of them which produce accurate results and can connect to any device near the antenna without any interruption while connecting the nodes in the network. Antenna will be the backbone of communication system with the technology used and innovation happening to develop the antenna. Antenna may be a good device that not solely transmit and receive however conjointly work as transducers. Also, the impact of slots on microstrip patch antenna and its parameters. The impact is shown on information measure, gain, pattern, come back loss, axial magnitude relation Associate in nursing the size of an antenna. The U-shaped slots on the patch or on the bottom plane can facilitate to style antenna with improved information measure and potency.

Keywords: Microstrip patch antenna, U-shaped slots, and IoT applications.

1 INTRODUCTION

Over the past few years, IoT has become one of the most dominant technology in the 21st century. IoT can also connect each remotely connected node with the help of wireless communication [1-3]. The Internet of Things (IoT) are the physical devices or nodes around the world which can connect with the internet. Also, collecting and sharing the data, compatible with designed device, creates attractive structure, beneficial both in investment and working of device with its low cost, small size, high performance, and adaptable to communicate with any type of technology [4-8].

IoT is referred to have a device with moderate data rate, low cost and can operate within the frequency of range 100 MHz - 5.8 GHz. By the year 2025, about 21 billion devices connected to the internet. IoT made human life very smooth and day-by-day developing technology under wireless communication. Moreover, IoT is being adopted in every sector in the world. The Internet of Things (IoT) will empower the connected nodes with new abilities. In this survey, the definitions, architectures, fundamental technologies, and applications had systematically reviewed.

However, this wireless communication can be implemented with different protocols, systems, networks, speed, media, structures, maintenance, distance between remote devices, environment and so on. The essential part for wireless communication is the antenna which connects all devices to the internet. There are variants with dual/multi-band antennae with flexible antenna structures for applications that require the antenna routed in IoT devices [9-16].

In this paper, both conventional and U-shaped slot antennas of different sizes were analysed to get better results
for the communication between devices even in remote areas. The simulation results of antenna were compared based on gain, VSWR, radiation, frequency of these antennae. The results were very clear and can have great changes in each type of antenna [17-32].

2 ANTENNA DESIGN

In this paper, the antenna designing is done with three various and distinct types of antennas. In the three cases, the first case is the conventional antenna and the second, third cases are U-shaped slot antennas with variation in loaded U-shaped antenna. With the operating frequency of 5.6 GHz.

Case-1: conventional antenna

The conventional antenna is taken as case-1 as shown in fig.1. The antennas are designed and simulated using time-domain solver of CST microwave studio suite. The antenna is simulated under PML boundary conditions. The simulations are shown in figure 4 to 9. The S-parameter is -15.8 dB for the operating frequency of 5.6 GHz is represented in figure 6.4 and the VSWR is represented in figure 5. The three-dimensional (3D) radiation pattern and two-dimensional (2D) radiation characteristics are represented in figure 6 & 7, respectively. the radiation pattern shows that the main lobe direction is 98 degrees with a magnitude of 2.08 dB. The simulated gain observed in the conventional antenna is 2.056 dB.

Fig.1. Design of Conventional Antenna (Case-1)

Case-2: U-shaped slot antenna-1

The U-shaped slot antenna-1 is taken as case-2 as shown in fig.2. The antennas are designed. The antenna is simulated under PML boundary conditions. The simulation results as shown in figure 8 to 12. The S-parameter is -15.1 dB for the operating frequency of 5.6 GHz is represented in figure 8 and the corresponding VSWR is represented in figure 9. The three-dimensional (3D) radiation pattern and two-dimensional (2D) radiation characteristics are represented in figure 10 and 11, respectively. The radiation pattern shows that the main lobe direction is 98.0 degrees with a magnitude of 2.03 dB. The simulated gain observed in the conventional antenna is 2.019 dB.

Fig.2. Design of U-Shapes Slot Antenna-1 (Case-2)
Case-3: U-shaped slot antenna-2

The U-shaped antenna-2 is taken as case-3 as shown in fig-3, the antennas are designed. The antenna is simulated under PML boundary conditions. The simulation results as shown in figure 12 to 15. The S-parameter is -13 dB for the operating frequency of 5.6 GHz is represented in figure 12 and the corresponding VSWR is represented in figure 13. The three-dimensional (3D) radiation pattern and two-dimensional (2D) radiation characteristics are represented in figure 14 and 15, respectively. The radiation pattern shows that the main lobe direction is 98.0 degrees with magnitude of 6.05 dB. The simulated gain observed in the conventional antenna is 1.790 dB.

3 RESULTS AND DISCUSSION

The results are compared between three various and distinct types of antennas. The results are secured with the help of multiple parameters like S-parameter (return loss), Voltage Standing Wave Ratio (VSWR), and 3D and 2D radiation characteristics as shown in the figures. The basic type antenna shown in figure 1 and the corresponding results are represented in figure 4 to 7 respectively.

Case -1: Graphs, 3D & radiation Patterns
Case -2: Graphs, 3D & radiation Patterns

The case 2 antenna simulation results are represented in figure 8 to 11. The return loss in figure 8 and corresponding VSWR is in figure 9. The 3D and 2D radiation patterns at resonant frequency of 5.6 GHz is represented in figure 10 and 11 respectively.
Fig. 8. Return Loss for case -2

Fig. 9. Voltage Standing Wave Ratio for case -2

Fig. 10. 3D pattern for case -2

Fig. 11. Radiation pattern of case -2
Case -3: Graphs, 3D & radiation Patterns

The case 3 results are represented in figures 12 to 15. The return loss in figure 12 and corresponding VSWR is in figure 13. The 3D and 2D radiation patterns at resonant frequency of 5.6 GHz is represented in figure 14 and 15 respectively.

Fig.12. Return Loss for case -3

Fig.13. Voltage Standing Wave Ratio of case -3

Fig.14. 3D pattern for case -3
Thus, the outcomes from the analysis have determined that the U-shaped slot antennas have clearly shown a great change in its performance as rather than conventional antenna. This is because of installing the U-shaped slots into the antenna. Moreover, the results have explicated U-shaped within the antenna and has succeeded with renewed performance than conventional antenna with the help of the simulation results of the parameters. The comparison of all the cases of results and included in table 1.

Table 1. Comparison of simulated results

<table>
<thead>
<tr>
<th>Case</th>
<th>Operating Frequency</th>
<th>gain</th>
<th>Return loss</th>
<th>E-field</th>
<th>M-field</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional antenna</td>
<td>5.6 GHz</td>
<td>2.056 dB</td>
<td>-15.8 dB</td>
<td>150.8 dBm</td>
<td>105.2 dBm</td>
</tr>
<tr>
<td>U-shaped slot-1 antenna</td>
<td>5.6 GHz</td>
<td>2.019 dB</td>
<td>-15.1 dB</td>
<td>151 dBm</td>
<td>105.4 dBm</td>
</tr>
<tr>
<td>U-shaped slot-2 antenna</td>
<td>5.6 GHz</td>
<td>1.790 dB</td>
<td>-13 dB</td>
<td>151.2 dBm</td>
<td>105.4 dBm</td>
</tr>
</tbody>
</table>

4 CONCLUSION

In this paper, designed some instances of microstrip antennas which can be adopted for IoT devices. Mostly, IoT devices use an antenna for wireless communication. So, the comparison of three different types of antenna has been done. In the three cases, the first case in conventional antenna and the second and third are U-shaped slot antennas with variation in loaded U-shaped antenna. The operating frequency is 5.6 GHz. The evaluation of these antennas is taken in terms of return loss, VSWR, radiation characteristics, Electric & Magnetic fields, and gain. Compared to conventional antennas the U-shaped slot antennas are holding less return loss. U-shaped slot antennas have more efficiency than the conventional antenna. All these antennas were designed and simulated using time-domain solver of CST microwave studio suite. The antenna is simulated under PML boundary conditions. The U-shaped slot antenna can be used for various IoT applications as it is operating frequency is in range of 5.6 GHz.

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